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# Laboratory Respirator Protection Level Testing (LRPL)

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# LRPL Purpose

**To evaluate respirator protective equipment for  
military and civilian applications requiring  
protection against nuclear, biological and chemical  
(NBC) warfare agents**

# Laboratory Respirator Protection Level Testing (LRPL)

## Relevant Test Standards and Protocols

- ◆ “Joint Service Standardization Agreement for Fit Factor Testing of Military Masks”, 1 Oct 91 (approved 8 Apr 92)
- ◆ “Protection Factor Testing of Respirators and Suit Ensembles”; Internal test protocol based on standardization agreement
- ◆ NIOSH Procedure N0. RCT-CBRN-STP-0001, 17 Nov 01, LRPL Test Quantitative (High Flow Deep Probe Corn Oil) For Self-Contained breathing Apparatus With Full Facepieces Standard Testing Procedure

# LRPL Test Chamber



- ◆ Rear- light scattering photometers
- ◆ Capable of measuring 100,000 PF
- ◆ Real-time measurement



# LRPL Test Chamber

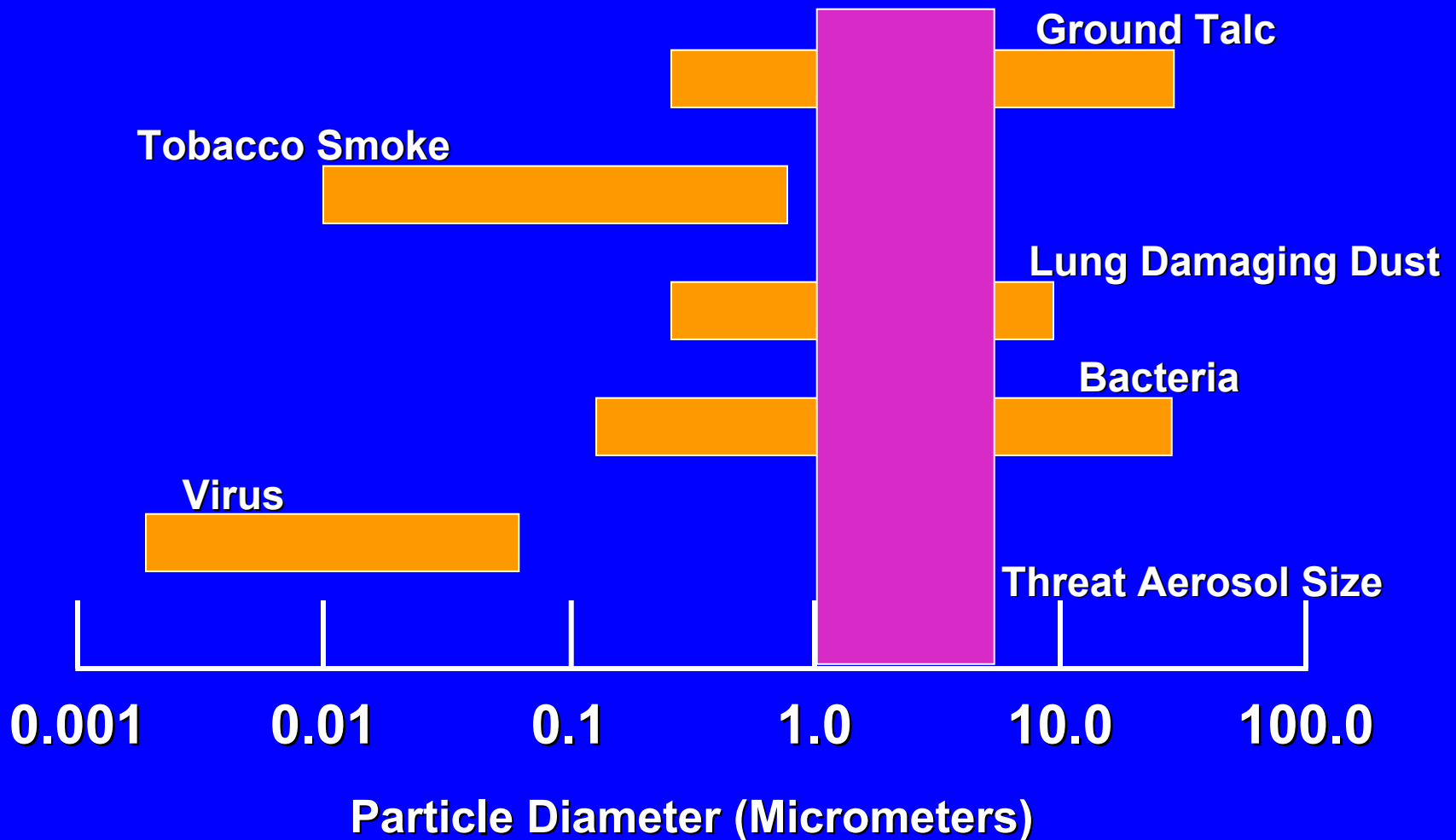


# Aerosol Challenge

- ◆ **Corn oil**
- ◆ **Concentration of 20 to 40 mg/m<sup>3</sup>**
- ◆ **Particle size of .4 to .6 microns (MMAD)**
- ◆ **The geometric standard deviation be less than 2.0**
- ◆ **Temperature 70F, Humidity 20%**

# Particle Size Comparison

## Threat Aerosol Size versus Common Particulate Material



# Protection Level

- ◆ **Expression of performance based on the ratio of concentration outside the mask to concentration inside the mask, or**

$$(C_o / C_i) = PL$$

- ◆ **Example: 1000 ppm /1.0 ppm = 1000**
- ◆ **In other words, the air inside the mask is 1000 times cleaner than the outside air**



# LRPL Exercise Routine

- ◆ Normal Breathing
- ◆ Deep Breathing
- ◆ Turn head side to side
- ◆ Turn head up and down
- ◆ Recite the rainbow passage
- ◆ Sight rifle
- ◆ Reach for the floor or ceiling
- ◆ On hands and knees, turn head side to side
- ◆ Facial expressions
- ◆ Climb stairs at regular pace
- ◆ Normal breathing

**One Minute Duration  
for Each Exercise**

# Escape Hood LRPL Data

PF	Frequency	Cumulative %	PASS %
0.0	0	.00%	100.0%
10.0	0	.00%	100.0%
50.0	0	.00%	100.0%
100.0	0	.00%	100.0%
500.0	2	4.17%	95.8%
1,000.0	1	6.25%	93.8%
1,667.0	1	8.33%	91.7%
2,000.0	0	8.33%	91.7%
5,000.0	2	12.50%	87.5%
6,667.0	2	16.67%	83.3%
10,000.0	3	22.92%	77.1%
20,000.0	18	60.42%	39.6%
50,000.0	15	91.67%	8.3%
100,000.0	4	100.00%	0.0%
subjects	48.0		

PF	Frequency	Cumulative %	Pass %
0	0	0.00%	100.00%
10	0	0.00%	100.00%
20	0	0.00%	100.00%
50	0	0.00%	100.00%
100	0	0.00%	100.00%
500	4	4.17%	95.83%
1000	2	6.25%	93.75%
1667	0	6.25%	93.75%
2000	0	6.25%	93.75%
6667	11	17.71%	82.29%
10000	0	17.71%	82.29%
20000	10	28.13%	71.88%
50000	11	39.58%	60.42%
100000	58	100.00%	0.00%
Total Trials	96		

# Sample LRPL Data

PF	Frequency	Cumulative %	Pass %
0	0	0.00%	100.00%
10	8	16.67%	83.33%
20	13	43.75%	56.25%
50	12	68.75%	31.25%
100	1	70.83%	29.17%
500	13	97.92%	2.08%
1000	0	97.92%	2.08%
1667	1	100.00%	0.00%
2000	0	100.00%	0.00%
6667	0	100.00%	0.00%
10000	0	100.00%	0.00%
20000	0	100.00%	0.00%
50000	0	100.00%	0.00%
100000	0	100.00%	0.00%
Total Trials	48		

PF	Frequency	Cumulative %	Pass %
0	0	0.00%	100.00%
10	0	0.00%	100.00%
20	0	0.00%	100.00%
50	0	0.00%	100.00%
100	0	0.00%	100.00%
500	1	2.13%	97.87%
1000	1	4.26%	95.74%
1667	0	4.26%	95.74%
2000	0	4.26%	95.74%
6667	3	10.64%	89.36%
10000	0	10.64%	89.36%
20000	0	10.64%	89.36%
50000	11	34.04%	65.96%
100000	31	100.00%	0.00%
Total Trials	47		

# Sample LRPL Data

## Hood

<i>PF</i>	<i>Frequency</i>	<i>Cumulative %</i>	<i>Pass%</i>
0	0	.00%	100.00%
10	0	.00%	100.00%
50	0	.00%	100.00%
100	0	.00%	100.00%
500	0	.00%	100.00%
1000	0	.00%	100.00%
1667	0	.00%	100.00%
2000	0	.00%	100.00%
5000	2	6.45%	93.55%
6667	1	9.68%	90.32%
10000	2	16.13%	83.87%
20000	3	25.81%	74.19%
50000	8	51.61%	48.39%
100000	15	100.00%	0.00%
Trials	31		

## Oral Nasal

<i>PF</i>	<i>Frequency</i>	<i>Cumulative %</i>	<i>Pass%</i>
0	0	.00%	100.00%
10	0	.00%	100.00%
50	0	.00%	100.00%
100	0	.00%	100.00%
500	0	.00%	100.00%
1000	0	.00%	100.00%
1667	0	.00%	100.00%
2000	0	.00%	100.00%
5000	1	2.94%	97.06%
6667	0	2.94%	97.06%
10000	6	20.59%	79.41%
20000	5	35.29%	64.71%
50000	10	64.71%	35.29%
100000	12	100.00%	0.00%
Trials	34		

# Summary of Results

**Escape Hoods Are capable of Meeting LRPL  
Values of 500 and Greater Utilizing a One Size  
Neck Seal System**